Designing Alternatives to State Motor Fuel Taxes

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All states rely on gasoline taxes as one source of funds for road improvement and maintenance. Historically, gasoline usage has been roughly proportional to road usage for most light vehicles, so the gas tax could be viewed as a user charge. Increasing fuel efficiency and alternative fuel vehicles reduce both the equity of the revenue source and its growth over time. At the same time, improved technology has made more direct pricing of road usage more feasible. This paper reports on the economic issues that arise in moving toward the more extensive use of road pricing as a substitute for fuel taxes.

by Anthony M. Rufolo and Robert L. Bertini

While roads are financed from a wide variety of sources, all states use motor fuel taxes as an important source of funds. Fuel taxes for automobiles and other light vehicles have historically provided a clear link between the use of roads and the financing of their construction and maintenance. However, changes in technology, leading to higher fuel efficiency, wide variations in fuel efficiency, and alternative-fuel vehicles, raise questions about the viability and equity of this revenue source. Hence, analysis of alternative revenue sources has become an important consideration for some state departments of transportation.

In Oregon, the legislature created a task force, the Road User Fee Task Force, to analyze these options and recommend a pilot program for testing the viability of some alternatives. Figure 1 shows that Oregon has relatively more reliance on the gas tax than other western states. Hence, the state is relatively more vulnerable to problems with the gas tax than other states. Figure 2 shows some possible projections of fuel tax revenue for Oregon. The projections are simply meant to illustrate the potential problem facing the state's road fund. The Oregon Department of Transportation commissioned a background report for the Task Force. This paper is a summary of the economic issues identified.

Background

There are several mechanisms that could be used to address the revenue and equity concerns associated with differing fuel consumption among vehicles. For example, the initial title fee could be varied by fuel efficiency of the vehicle, with higher-efficiency vehicles paying the discounted present value of their expected fuel tax savings when the vehicle is registered. Alternatively, the annual registration fee could be based on fuel efficiency. In fact, Oregon started charging hybrid vehicles a higher registration fee this year for precisely this reason. While such approaches address the revenue needed for road finance, the tendency has been for incentives in the opposite direction. For example, the federal government once levied a gas-guzzler surcharge on low-efficiency vehicles; and there are a variety of incentives offered for alternative fuels and more fuel-efficient vehicles, particularly in air quality nonattainment areas. Hence, the concerns for road finance tend to be in conflict with the desire for incentives to improve fuel efficiency and to develop vehicles that use alternative fuels. In addition, charges that do not vary with vehicle use tend to create equity issues between vehicles that are used intensively and those that receive little use. Further, vehicles that travel through the state and are registered in another state would not be subject to the charges. Thus, while such alternatives should not be dismissed, more direct pricing of road use appears to be a more viable approach to road finance; and this paper will focus on the various approaches to road pricing for automobiles and other light vehicles.

While road pricing generates revenue, certain types of pricing also focus on managing congestion. Economists have argued for years that congestion pricing could be used to encourage more efficient use of roads, but the improvements in technology are making such price variations much more feasible than they once were.

At present, examples of direct road pricing for automobiles and light vehicles are almost exclusively in the form of toll pricing. With recent advances in technology reducing the cost and inconvenience of collection, tolls have the advantage of being relatively simple to collect and are being tested under a variety of circumstances. New technologies have also meant that more sophisticated types of road pricing are becoming technically feasible. Major issues with the more advanced systems are cost and privacy. The cost is likely to decrease over time and with more widespread applications, cost becomes much less of an issue if the technology is already in place for some other reason. For example, a standalone global positioning system (GPS) for an automobile may cost hundreds of dollars, and this expense would be high relative to existing levels of state fuel taxation. However, systems currently used

Figure 1: Reliance on Gas Tax

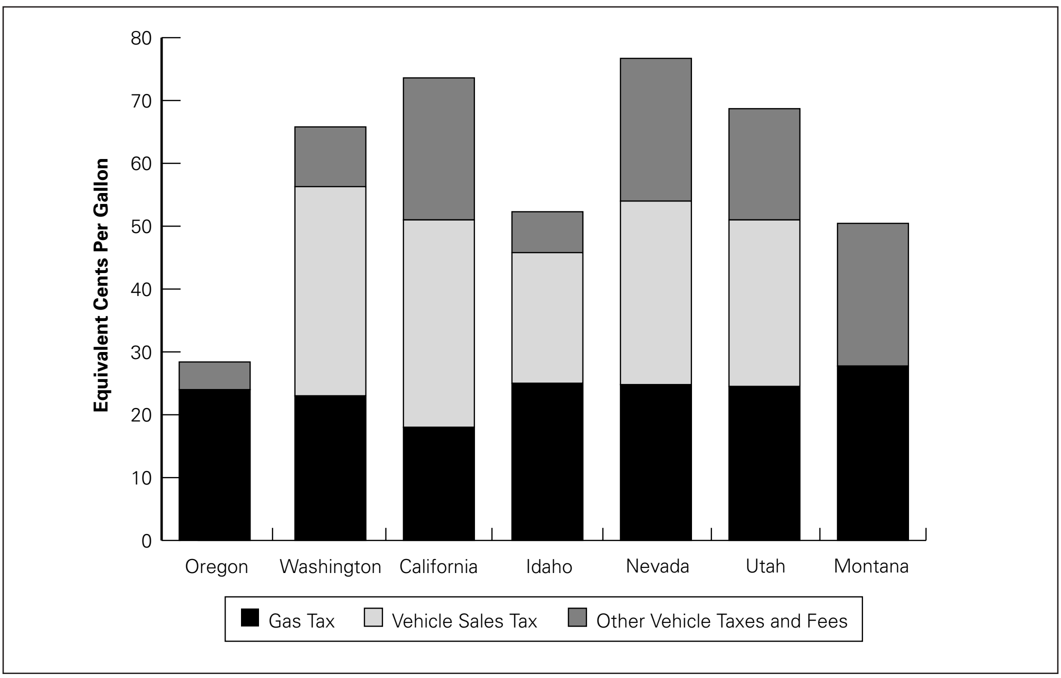
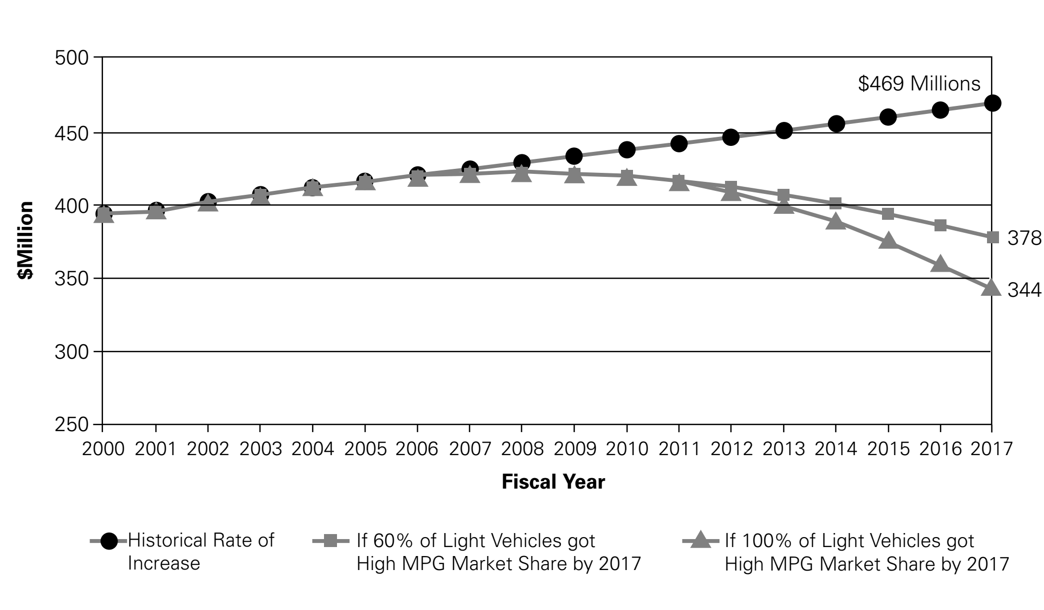


Figure 2: Reliance on Gas Tax



for other purposes could be adapted for road pricing at a much lower cost. For instance, a system demonstrated by Progressive Insurance in Texas monitored vehicle use for insurance purposes. The information from this system could also be used for many road-pricing systems.

Propulsion Technology

Gas tax collections are sensitive to the average fuel economy for gasoline-powered vehicles and to the use of alternative fuels. Alternative fuels may be subject to other taxes to offset the loss of gas tax revenue, but higher efficiency vehicles are more problematic in terms of the impact on tax revenue and the equity of road use charges among vehicles.

A variety of alternative fuel vehicles (AFVs) exist. However, only a limited number appear to have high potential to achieve significant market share in the foreseeable future. Hybrid electric vehicles (HEVs) are the most likely to achieve significant market penetration in the near term, and those currently in production rely on small gasoline engines. Hence, their impact on gas tax revenue is actually through much higher fuel economy. Major US automobile manufacturers plan to introduce hybrid-electric pickup trucks and sport utility vehicles in the next few years (Transportation Research Board 2001). Nevertheless, Orski (2001) argues that US automakers see fuel cell technology as the ultimate solution and are reluctant to invest significant resources in hybrid technology, which they view as an interim solution. He also believes that the fuel cost savings for most users in the US (estimated as $800 over the first 50,000 miles) is not high enough to justify the $3,000 that a hybrid engine adds to a vehicle's cost. While tax credits and other incentives somewhat offset the cost differential, it seems unlikely that large incentives would remain if hybrids increased dramatically in sales. Higher fuel prices in other countries are likely to make the hybrids more attractive abroad, and an increase in fuel price in the US or reduced cost for the hybrid engines would make the hybrids more attractive here. However, this does not seem likely in the near term.

Alternative vehicles that use other energy sources fall into two categories. There are those that consume a different fuel and those operated purely by electricity. While alternative fuels create problems for the gas tax, those fuels that are consumed could be subject to taxation in most cases, with some such tax systems already in place. Mintz (2000) reports that federal taxes for motor vehicle use of liquefied petroleum gas and liquefied natural gas are higher than the energy equivalent tax on gasoline, while the taxes on compressed natural gas and ethanol are lower. Further, some states have similar tax structures in place, demonstrating their feasibility. However, most analysts do not see much market penetration for such vehicles outside of specialized fleets. A significant issue is that AFVs using compressed natural gas, ethanol, and methanol are disadvantaged because of limited fuel availability. Many are configured as flexible fuel vehicles (FFVs) and can often run on traditional fuels.

Electric vehicles would create a much more substantial concern from the perspective of road taxation. It would be difficult to track electricity for road usage and difficult to tax only such uses. However, the pure electric car does not seem likely to generate a large market share. Most electric vehicles on the road today are currently being leased from auto manufacturers and exist largely in fleet applications. Markets for "city cars" and neighborhood electric vehicles are starting to emerge (California Energy Commission 2000), but the limited range, low speeds, and related problems make them unlikely to achieve a large market share other than in specialized applications. Fuel cell technology is advancing rapidly, and a significant advance could make an electric alternative more feasible, but production vehicles are still many years away (TRB 2001). Fuel cell vehicles also necessitate a new fueling infrastructure (e.g., hydrogen) that would take time to develop once the vehicles became viable.

Reno and Stowers (1995) concluded that the gas tax was likely to remain a major revenue source for at least three decades. While changes in technology appear to be moving faster than anticipated, the demise of the gas tax does not appear to be imminent. With energy equivalent taxes on other fuel sources, the major concern from the revenue perspective would be the increase in fuel efficiency, which implies that revenue will not keep pace with road usage, and that equity among vehicles would not be maintained.

Experience With Alternative Revenue Systems

There has been a wide range of experience with alternatives to the gasoline tax. Toll roads have been the most widely used alternative, with many major systems in the US and other countries financed by direct charges for using roads, bridges or tunnels. Tolls are typically levied either for entrance into a limited access facility or are levied at various points along the road. More recently, several countries have experimented with a cordon system, whereby toll stations encircle an area and a fee must be paid to enter the area; or with tolls levied throughout the road system. For example, it would be possible to charge a vehicle each time it passed a toll point on the road system. With current technology, there are several variants that are feasible. State Route (SR) 91 in California uses a single toll point with a variable price for toll lanes constructed in the median of an existing freeway, based on the general congestion level. Many roads on the East Coast have long collected tolls at on-ramps and various points along the road. They are now converting to electronic toll collection, with substantially reduced costs for administration and compliance at the many toll points.

In general, improved technology has made tolling relatively more attractive as a road finance option; however, there is substantial resistance to the introduction of tolls on previously "free" roads, especially in the US. Most tolls in the US have been instituted at the time of construction, and there appears to be substantially less resistance to tolls on new roads than to tolls on existing ones. However, several countries have successfully imposed toll schemes. It appears that most of the toll systems imposed in Europe were used to finance additional road supply even when imposed on an area rather than a specific road. Acceptance of this alternative to higher gas taxes might also be due to the much higher gas taxes already levied. Singapore is still the major example of the imposition of new tolls to manage congestion. A variety of other plans have been proposed to either raise revenue or control congestion but were never adopted.

The Federal Highway Administration (FHWA) Value Pricing program has provided funds to promote experience in more directly pricing road usage. The following summary of projects and experience comes largely from FHWA (2001). FHWA classifies the projects as falling into one of four categories: higher peak-period tolls on existing toll facilities; conversions of high occupancy vehicle (HOV or carpool) lanes to high-occupancy toll (HOT) lanes; variable pricing of new capacity; and conversion of fixed costs of driving to variable costs. The first three categories provide direct information that is relevant to using pricing as an alternative to fuel taxes.

The only project with substantial experience under the first category, higher peak period tolls on existing toll facilities, is the Lee County, Florida project. In this project, existing toll bridges had their tolls reduced during the off-peak (shoulder) periods to induce traffic out of the peak. To take advantage of the discount, drivers had to use an electronic toll system. Experience with the system has been positive despite the fact that the monetary savings are small ($0.25 per crossing for most users). This project helps demonstrate the feasibility of time-varying tolls on existing toll facilities, and projects are underway to implement some time-varying tolls on existing facilities in New Jersey and New York. Since the Lee County toll was a reduction for off-peak usage, much of the controversy involving equity was avoided. Estimates of the shift in usage indicate some smoothing of the peak, and public acceptance has been high. There are now proposals to look at more extensive use of pricing, such as allowing queue jumping, i.e., allowing vehicles to bypass lines at toll booths, for a higher fee.

In the second category, conversion to HOT lanes, there is more experience; but the most discussed project is the Interstate 15 (I-15) conversion in San Diego. This facility is an eight-mile, two-lane reversible barrier-separated HOV facility that was underutilized. The project allows single occupant vehicle (SOV) users to pay a fee to use the facility while it remains free for HOV users. The most significant difference for this project is the use of dynamic congestion pricing. The HOV rules for California require that a specific level of service be maintained on the HOV lanes. Hence, the fee for access is adjusted every six minutes to maintain the required service level. The fee is posted on variable message signs prior to the entrance to the facility. The fee can typically go as high as $4.00 under normal traffic conditions and as high as $8.00 when there are accidents on the adjacent freeway. Acceptance has been high and there are plans to extend the facility. This is particularly noteworthy since most previous studies found strong resistance to the concept of dynamic pricing. The key difference appears to be that in previous proposals, the fee would vary after the driver had made a commitment to enter a facility. Hence, the driver faced uncertainty over the price and often could not change behavior in response to price changes. This facility provides pricing information to the driver in real time before a decision is required. Thus, dynamic pricing appears feasible if the driver knows the price before a decision is made.

The SR 91 express lanes illustrate the use of fixed rates that nevertheless vary by time of day and day of week. Initially there was a fixed fee during the four-hour peak period. This rate structure was adjusted to a fee that changed every hour, and the fee could be different for the same hour on different days. This illustrates that it is possible to set fees that vary by time of day but to have those fees change at specific times set in advance. With this system, drivers know in advance what it will cost to use the facility if they arrive at a specific time. The major disadvantage of such systems is setting the fee appropriately to maintain flow. If the fee is too high, the facility is underutilized, while a fee that is too low promotes congestion. The fee on SR 91 has varied to induce some smoothing of the peak, but the evidence indicates that the price differentials have not had much effect on the pattern of usage within each rush-hour period.

SR 91 is the major example of congestion pricing on new capacity. The facility initially allowed free use by carpools but changed this to a 50% discount. There has been extensive analysis of this project. In particular, usage patterns have demonstrated that many lower-income people are willing to pay the toll for faster trips, although not as frequently as higher-income people. It also appears that people use the facility selectively, with relatively few users using it every day.

Other countries have more extensive experience with pricing. Small and Gomez-Ibanez (1997) report that pricing programs based upon toll rings surrounding city centers have been implemented in the Norwegian cities of Bergen, Oslo, and Trondheim. All three Norwegian programs aim to generate revenues to finance major road improvements in their respective regions rather than reduce congestion per se. Autoroute A1 connecting the cities of Paris and Lille, France, is a single-facility congestion-pricing program. In an effort to manage traffic more effectively, a revenue neutral pricing program was implemented using fees that vary by both time and distance. Cities considering area-wide congestion pricing programs include the Randstad region of the Netherlands and London, England. Both systems were proposed as multiple-cordon systems with the London plan also charging tolls for crossing internal screen lines that would divide central London into six cells. Neither project was implemented because their overall size and complexity raised a number of public concerns. A new proposal for London aimed at reducing congestion in the central area, with proceeds used to finance public transportation improvements, appears to be gaining popular support (FHWA 2001) and is currently being implemented.

Administrative and Compliance Cost

While all toll systems seem to be relatively more expensive to operate than the existing gas tax system, costs are declining over time and appear to be within the range of cost of other tax systems. The scope of the system and its complexity affect the administrative and compliance costs.

Value pricing projects that are fairly simple in design and involve either a single facility or a single cordon are much more likely to be successful than elaborately designed projects that often never make it out of the planning stages (Small and Gomez-Ibanez 1997). Small-scale projects lend themselves to the use of proven electronic toll collection and enforcement technologies. Besides low collection costs, electronic toll collection allows for variable pricing, produces a stable revenue stream, and has low evasion rates (Forkenbrock 1997). Electronic toll collection is typically based upon automatic vehicle identification (AVI) technology in the form of transponders and receivers. Enforcement is commonly undertaken through a combination of video license plate recognition technology and law enforcement patrols. Evasion rates for AVI-based enforcement systems are estimated to be approximately 3-5% (Supernak et al. 2001).

Much of the discussion related to broad-based alternatives to fuel taxes focuses on some sort of charge for vehicle miles traveled (VMT). These charges may be flat or vary by time of day or location. The actual design of the program will have a significant bearing on costs. For example, a flat VMT fee can be based around a vehicle inspection program, annual self-reporting, or electronic monitoring of the vehicle. The cost of annual self-reporting would be the lowest in terms of administrative and compliance cost, but it would also create the highest potential for evasion. The use of special equipment such as hubodometers, in-vehicle meters, and transponders will add to compliance and administrative costs.

A set of estimates for administrative and compliance costs of a mileage-based tax was generated in a Minnesota study (Wilbur Smith Associates 1997). This study concluded that systems based on existing odometer readings would lead to unacceptable levels of evasion. Three options were evaluated. The lowest technology option would be a tamper-proof chip to store vehicle information, and the highest would be an electronic odometer coupled with devices at the state border to allow for differentiation of in-state and out-of-state travel (p. 43). Estimates of cost ranged from $20 to $100 per vehicle for equipment and installation of the appropriate technology. They estimated that the cost of equipping the state's 3,500 gas stations and 35,000 fuel pumps with equipment to monitor fuel-tax exemptions at about $56 million at that time. Antenna reader devices at major border crossing locations were estimated to cost $17 million. They estimated additional annual operating and maintenance costs of $19 million to $55 million (pp. 53-54). The study concluded, "the concept of a mileage-based tax is technically feasible, but does not appear to be cost-effective *at this time, particularly if implemented by a single state*" (p. 56). While the single-state comment reflects issues that arise in tracking residents and nonresidents, it also appears to reflect potential benefits of coordination with federal vehicle taxes. Adoption of a VMT based system by the federal government, or in cooperation with the auto industry, would substantially reduce the cost for adding such a tax at the state level.

All of these cost estimates are subject to substantial variation, but they indicate that a variety of alternative finance measures are feasible at modest cost levels, but that the more sophisticated ones can become quite costly. Some of the costs could be expected to decline over time.

Revenue

The basic objective of the road finance system is to raise revenue for the construction and maintenance of the system. All alternatives to the fuel tax currently in operation have been designed to augment existing gasoline taxes rather than as a replacement for gasoline taxes. While substantial revenue has been generated in specific applications, there has been relatively little analysis of the ability of the alternative systems to raise as much revenue as the gas tax. In particular, the gas tax is levied at all times and all locations, while many of the alternatives look at a limited set of locations or variation by time of day. Even with roads, such as SR 91, that use tolls to pay off construction bonds, there is some question as to whether the toll revenue would be sufficiently high if applied to the entire road system. For example, Sullivan

(2000, p. 6) notes, "it is rare for a new urban highway project to have the SR 91's unusual combination of relatively low capital costs (less than $3.5 million per lane-mile), large demand, and a favorable institutional environment for quick implementation." Discussion of alternatives should address whether the new option would be an addition to the gas tax or a replacement. Many of the studies of public acceptance for alternative finance schemes find that people are more accepting of alternatives if they would get reductions in other taxes, and any large scale mandatory system would almost certainly have to address the gas tax. However, there is currently no experience with such a system and none of the existing projects adjust gas taxes.

Revenue estimates for complete replacement of the gas tax as the major source of taxation for light vehicles are likely to be relatively easy to generate. For example, Oregon's 24 cents per gallon gas tax generates about 1.2 cents per mile given a fleet average of 20 miles per gallon. The complex part of the question is to generate revenue estimates when there is only partial replacement and to identify mechanisms to compensate for gas taxes paid in addition to the alternative. However, any system to phase in a replacement would have to address such concerns.

The most basic revenue question in looking at alternatives to the fuel tax is whether the alternative is expected to supplement the fuel tax or to replace it. Supplements must be evaluated relative to their objectives. For example, a supplement may be intended to generate the equivalent to gas tax revenue for an alternative fuel vehicle, or it may be intended to finance a new construction project. Revenue replacement for the fuel tax on alternative fuel vehicles is likely to be relatively simple in terms of revenue forecasts, and the source is likely to be as stable as the gas tax. Similarly, mandatory alternatives that completely replace the gas tax should generate relatively simple analyses for revenue potential and stability. The revenue potential for most other alternatives will be more difficult to estimate. In particular, tolls that are intended to fund specific improvements are likely to be problematic; and for voluntary participation, there is likely to be self-selection, with higher probabilities of participation for those who are most likely to save money under the alternative system and lower participation likely for those expected to pay more. The data for many of these calculations are problematic, and the feasibility of an accurate forecast will depend on the type of project, the reliability of data related to the activity being taxed, and the estimates of people's responses to such taxes in terms of behavior changes. For example, there are a variety of estimates of people's likely response to a price increase for using a road, but the response will vary tremendously depending on whether one or all lanes are priced and on the nonpriced alternatives available.

Equity

Equity issues are raised in a variety of contexts when discussing road finance. The most important of such issues are equity between vehicle classes, equity between income groups, and geographic equity. When considering new systems that may only partially replace the fuel tax or that may be phased in over time, concerns about double taxation are also raised.

Oregon addresses the equity between major vehicle classes by separating light (less than 8,001 pounds), medium (8,001 to 26,000 pounds) and heavy vehicles (over 26,000 pounds). Light vehicles almost exclusively pay the gas tax. The general reasoning has been that among light vehicles, the heavier ones impose greater cost on the road system and also tend to get lower gas mileage, thus paying a larger tax. With the wide variation in fuel efficiency and potential for alternative fuel vehicles, this assumption is no longer valid. Hence, from the perspective of equity within the light-vehicle classes, the current gas tax will create a greater and greater distortion over time. In addition, the relationship between fuel usage and road cost is by no means exact, so alternative pricing schemes offer the potential to tie taxes more closely to the cost imposed on the road system. Finally, congestion also enters into the equity discussion since those traveling at congested times create a demand for additional capacity that implies greater cost than for those traveling at uncongested times. While the equity issue is not typically discussed with respect to differential pricing during congested periods, it is relevant from this perspective.

Equity among income groups is typically the most sensitive issue in evaluating changes in tax systems. While the gas tax appears regressive when viewed from an ability-to-pay basis, it is generally judged as a user fee for the road system. Changes in the system, particularly ones that allow for optional fee-based use, are often seen as providing benefits disproportionately to those with higher incomes. Thus, toll lanes or HOT lanes are often derided as "Lexus Lanes" for the rich. While higher-income people are more likely to make the payments, there are several relevant perspectives. The first is that a tax primarily paid by higher-income individuals might be considered desirable in many ways, and there is substantial evidence that higher-income families are more likely to be driving in congested traffic than lower-income families (Svadlenak and Jones 1998). The second is that experience with pricing indicates that many lower-income families are willing to pay the price even when free (but congested) alternatives are available, indicating that the benefits of the time savings outweigh their costs (Sullivan 1998; Sullivan 2000). Nevertheless, there have not been comprehensive analyses of the impact of alternative finance systems on the overall incidence of the finance burden. If toll users are paying the full cost of the lanes and also contributing gas tax funds for other road use, it is hard to see how this disadvantages the nonusers. However, if the toll roads are not self-financed and there is a substantial differential in usage by income category, then the issue becomes more relevant. A variety of methods exist to address such equity concerns, such as "lifeline" rates or other low-income price breaks. Few toll roads would be good candidates for self-financing, since most studies conclude that demand must be quite high and existing congestion conditions severe to allow a priced road to sufficiently compete with unpriced lanes. Hence, the equity impact of proposed toll roads that also require general road fund support may warrant further analysis.

Geographic equity implies that road funds should be spent roughly in proportion to their collections by geographic area. Each of the alternatives to the gas tax would alter the geographic distribution of taxes. For example, cordon pricing around urban areas would generate additional funds from these areas. Similarly, toll roads would generate revenue from the specific roads, again more likely to be urban roads. On the other hand, replacement of the fuel tax with a VMT fee might tend to shift the tax burden toward rural areas since city fuel efficiency is typically expected to be lower than fuel efficiency in rural areas. Hence, for an equivalent amount of revenue, city drivers would tend to see lower costs under a VMT fee while rural drivers would tend to see higher ones.

Efficiency

Taxes typically distort decision making and lead to costs to the economy that are greater than the revenue generated for government. By comparison, prices for goods or services tend to lead to more efficient use of resources by making people evaluate the benefits that they receive versus the cost of provision.

Many people argue that the gas tax promotes efficiency in road use because the gas tax is essentially a price for using the system. While this argument has merit, it ignores the differential cost of providing road capacity at different times of day or in different locations. The potential for alternative finance schemes to incorporate congestion pricing has generated the most attention from economists. Yet public resistance appears to be greatest where the tolls are intended to accomplish more efficient usage. Recent experience confirms that people do change their behavior in response to tolls, and that this could substantially improve the use of the road system. However, there are serious questions raised when one part of the system is subject to charges and other parts are not. For example, Small and Yan (2001) raised the issue of whether tolled lanes in parallel with free lanes, such as SR 91, actually generate a welfare improvement over the same number of lanes, with all free. While there seems to be a general conclusion that the toll lanes improve efficiency, it does raise questions about the overall efficiency effect and how sensitive it is to the price and other characteristics. While most studies still conclude that the existing pricing experiments have improved efficiency, any system that is selective or phased in over time would have to be evaluated for its impact on the rest of the road system. This would be particularly important for systems that incorporate congestion pricing.

While congestion related pricing is expected to improve efficiency in general, much would depend on the specific method of implementation. For example, a general pricing scheme based on GPS monitoring of all vehicles would almost certainly improve efficiency. However, a system of imposing congestion prices only on freeways at specific times could reduce efficiency by creating incentives for drivers to switch to unpriced alternate routes.

Public Acceptance

As noted earlier, there is substantial public resistance to pricing roads that were previously "free." This is particularly true where the price is seen as a clear increase in cost for the motorist. Many motorists see an added toll as a form of double taxation. Hence, replacement of the gasoline tax with a VMT charge may be more acceptable than selectively adding charges with no reduction in other taxes and fees.

Perhaps the biggest change to promote public acceptance has been the change in focus from pricing options as a means to raise revenue to pricing options as a means to offer travelers alternatives, hence the term "value pricing." In particular, the projects in the US that have been successful have almost exclusively focused on providing additional choices rather than reducing the options available.

The value pricing projects for I-15 in San Diego and the Katy Freeway in Houston involved the conversion of HOV lanes to HOT lanes. The I-15 project sought to utilize excess capacity in the HOV lanes and to finance express bus service in the corridor. The aim of the Katy Freeway project was to make use of excess HOV capacity following an increase in the minimum vehicle occupancy from two to three persons. SR 91 differs from the above two projects in that pricing is used as a mechanism to generate sufficient revenues to pay for the financing of the facility. Persons who value their time highly can buy into the tolled lanes and be assured of shorter travel times and greater reliability. Users of unpriced lanes also benefit because overall freeway capacity is increased. Analyses of the I-15 and SR 91 projects show that the majority of users do not use the priced lanes regularly, but are instead more discriminate in their use of the pricing option (Sullivan 1998; Golob, Golob, and Supernak 2001). Post-implementation surveys for each of the projects have shown that people are generally supportive of road pricing, with users of the priced lanes showing somewhat greater support than users of the unpriced lanes. Of note is that public acceptance levels were shown to decrease following sudden price increases on SR 91 and with the introduction of dynamic (real-time) pricing on I-15, although they have since increased (Golob, Golob, and Supernak 2001; Sullivan 2001)

Studies involving I-15 and SR 91 state that the pricing programs do not appear to draw patrons from bus service operating in the same corridor (Sullivan 2000; Golob et al. 2001). Determining the actual impacts on bus ridership has proven more difficult. Early concerns that improved traffic conditions would shift riders from transit onto the toll roads have proven to be unfounded. The impacts of the pricing programs on the rates of carpooling have been shown to be slightly positive or neutral (Sullivan 2000; Supernak et al. 2000).

Border Issues

While states typically do not think about the direct relationship of their actions on neighboring states, experience in the taxation of trucks has proven that some form of interstate cooperation and coordination is important to make the system work effectively. Thus, interstate trucks report their mileage in each state under the International Fuel Tax Agreement (IFTA), and fuel taxes are adjusted and redistributed to reflect where the fuel was used rather than where it was purchased.

Coordination of tax policy has not seemed to be a particular problem with gasoline taxes since most states tax gasoline within a relatively small range. Rhode Island had the highest state gas tax in 2001 at 29 cents per gallon, and Georgia had the lowest at 7.5 cents per gallon. However, 40 of the contiguous 48 states had tax rates in the relatively narrow range of 17 to 26 cents per gallon. Further, tax differentials for gasoline are not likely to matter much unless there is a substantial population at the border of two states with a large differential. Of the seven contiguous states with rates below 17 cents per gallon, New Jersey's 10.5-cent rate as compared with New York's 22-cent rate and Pennsylvania's 26-cent rate, would appear most likely to create border problems. These differentials may be somewhat mitigated by the tolls required crossing between these states at the major population centers, but they do indicate that it is possible to have fairly large differentials without any specific policy. However, complete adoption of an alternative to the gas tax does have the potential to create border problems.

Similarly, a state with a system different from the gasoline tax would need to have a mechanism for collecting charges from out-of-state cars and for crediting in-state drivers for travel out of state. This is not a problem for certain types of charges, but becomes more of a problem as the new system becomes an extensive replacement for the gas tax. The literature appears to offer little guidance on how to deal with this issue, and it has not been a factor in the existing trials.

Transition

Transition from the current tax system to an alternative will create both administrative costs and equity issues. One of the major conclusions from the FHWA Value Pricing experiments is that voluntary systems that offer people an option avoid many of the equity concerns and resistance to alternative revenue sources. Even if the ultimate goal is to completely replace the fuel tax, consideration should be given to a voluntary option as a transition for implementation of any new revenue source. This is particularly true if the new source relies on relatively expensive technology. The cost of retrofitting existing vehicles would be a significant deterrent to adoption.

Voluntary systems must offer users an incentive to change, and they also create potential for evasion. The incentive to use the alternative could be either lower overall cost or better services. In the Value Pricing experiments, both types of incentives have been used. New toll lanes or HOT lanes offer better service for the fee paid, while the Lee County bridge tolls offer a discount to people who adopt the new technology and travel outside the peak. In both cases, many users have not adopted the new technology, and substantial resistance would be expected if there were a general mandate to do so.

In looking at alternatives to the fuel tax, some consideration must be given to the intent of the new system. If it were intended to be a supplement to the fuel tax, then the alternative would most likely be no reduction in service for those who choose not to use the new system. This is the situation seen with most of the value-pricing projects. If the intent is to replace the fuel tax, the alternative must allow for the avoidance or rebate of fuel taxes. The avoidance or rebate of fuel taxes is likely to create substantial administrative and compliance costs. Oregon has experience with a system whereby some heavy vehicles pay fuel taxes and others do not. With heavy vehicles, the tax is typically much higher than it is for light vehicles, and there is more need to differentiate by weight, since the road costs are much more affected by weight differences for heavy vehicles than for light vehicles. Hence, the cost of similar systems for light vehicles would be larger as a percentage of tax collected. Currently, in Oregon heavy vehicles that pay the weight-mile tax are exempted from the state's diesel fuel tax; but the methods of monitoring the tax exemption are not highly sophisticated, since the tax difference is almost exclusively based on vehicle weight. A more complex system would almost certainly be needed for light vehicles, and the cost would be commensurately higher.

Conclusion

The tax on gasoline is likely to remain a major revenue source for states for many years, yet the growing issues created by improved gas mileage and alternative fuels argue for consideration of a supplementary revenue source that may eventually replace the gas tax. Improved technology has substantially increased the viability of tolling as a revenue source, but new technology is creating the option of much more sophisticated road pricing systems. The transition to a new revenue source is likely to be complicated, but early planning and ongoing research can provide guidance on the appropriate replacement and the technology to implement it.

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